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August 3, 2019

Perry Lake Developments
31 Sterns Court
Dartmouth, NS
B3B 1W7
Attention: Mr. Larry Gibson

RE: PROPOSED SUBDIVISION - DRAINAGE REPORT - INGRAM DRIVE, FALL RIVER, NOVA SCOTIA

Dear Larry:

Further to our conversations, we have prepared drainage report for the proposed Fall River South Development.

We have examined pre and post development drainage scenarios using the NRCS (SCS) method, with curve numbers ranging from 75 to 90. We evaluated 2, 5, 10, 50 and 100-year storms in our preliminary analysis; and a 100-year storm for the storm water runoff leaving the property. Peak flows for the 100-year storm range from 32.64 cfs (pre) to 65.41 cfs (post), based on IDF curves from Halifax International Airport.

Since the post-development storm flows exceed the pre-development flow and a "net zero" flow is required, we will have to use mitigations methods to achieve our goal. The primary mitigation method is detention in some form, either at surface (pond) or underground storage. This decision will be made during the final design process.

I trust this is the information you require, but should you have any questions please contact me at 902-678-2774.

Yours truly,

ORIGINAL SIGNED

A. W. Dewar, P. Eng.
AWD/ajs
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INGRAM DRIVE

Drainage Report

ABLE Engineering Services Inc.
4 Calkin Drive, Kentville, NS B4N 3V7
Phone: 902-678-2774

A. W. (Sandy) Dewar, P. Eng.
a.dewar@ableinc.ca

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REGISTERED PROFESSIONAL ENGINEER
DATE 08/08/19
ORIGINAL SIGNED
A.W. DEWAR
2937
PROVINCE OF NOVA SCOTIA

1.0 INTRODUCTION

The proposed development by Perry Lake Developments is located in the south end of the community of Fall River, Nova Scotia. It is bound on the north and west by private lands, on the east by Highway 102, and on the south by CNR railway. The total drainage area is approximately 29 acres. The drainage catchment area consists of two (2) separate sub catchment areas, one (Pre A1) to the northeast (15.5 acres), the second (Pre A2) to the south (13.5 acres).

Although the development consists of two separate drainage areas, we need to examine the whole development in order to get a clear picture of how the rainfall runoff flow patterns change from pre-development to post-development. This information is essential for stormwater management and mitigation of development challenges. This information will also allow the allocation of drainage sub-areas to be directed to the most beneficial outlet from the development.

The primary cover of the property is presently treed. The area Pre A1 is relatively flat land and slopes slightly to the north boundary. The area Pre A2 slopes moderately to the south towards the CNR right-of-way.

Presently, the storm water runoff flows overland to existing drainage areas, to a wetland in the north (Pre A1), and to CNR drainage system and Three Mile Lake in the south (Pre A2). Given these are normal runoff flow conditions, we have concentrated our drainage evaluation to pre and post development flows during 2, 5, 10, and 100-year storms.

2.0 PRESENT CONDITION

The present contours of the property separate it into two sub-drainage areas, labelled Pre A1 and Pre A2 (ABLE #Y2019-059-02 Drainage Plan - Pre-Development).

- Drainage area Pre A1 is 15.5 acres in size, and lies in the northeast portion of the property. This portion slopes slightly to the north into an unnamed wetland.

- Drainage area Pre A2 is 13.5 acres in size, and it lies in the southern portion of the property, and it slopes moderately to the south, eventually into Three Mile Lake.

During a rainfall event storm water runoff will flow as above.

3.0 FUTURE CONDITIONS

The future drainage patterns will be very similar to the existing patterns, except the topography will change slightly due to development. The storm water from the northerly (Post B1) area will continue to drain into the existing wetland to the north. The only development change in Post B1 will be two 30-foot wide strips 600 feet long; otherwise, the area will be undisturbed. See ABLE plan #Y2019-059-03 Drainage Plan - Post-Development.

The South (Post B2) catchment area will be developed (143 residential units), roadways, parking, and lawn areas. The roof drains and roadway/parking will drain into a collection system and eventually to the CNR drainage ditches, and then to Three Mile Lake.

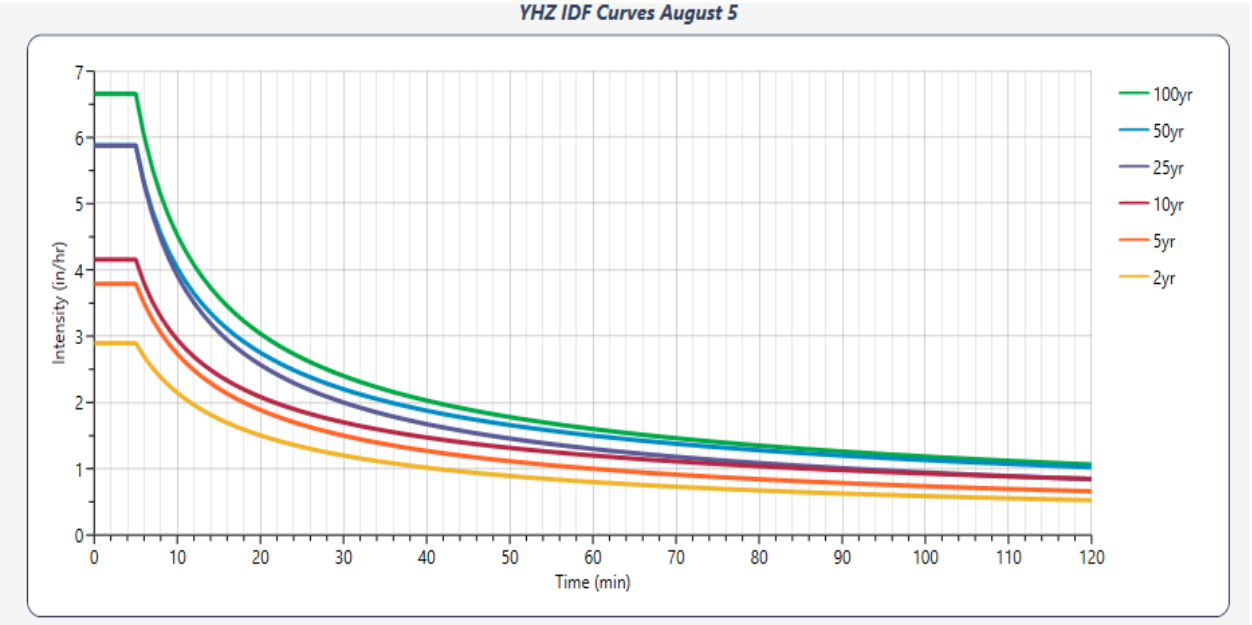
As with any large residential development, when there is a significant difference (23.4 cfs) between pre and post storm runoff, detention is usually recommended. Detention is sized to store storm runoff for such a time as to have a "net zero affect" between pre and post-development storm water runoffs, in order to release storm water at a flow rate of not greater than before development. This is achieved by controlling stormwater released using small diameter pipes and/or weirs. The recommended detention pond volume was estimated to be 31,656 cu ft), and is to be built when full development warrants.

4.0 FLOW EVALUATIONS ASSUMPTIONS

Hydrology Studio, a computer modelling program was used to evaluate the Pre and Post development stormwater flows and conditions, and the development of a detention pond. The following assumptions were used in our evaluation:

- Method of calculation – SCS Method
- Units of measure - imperial
- Runoff Curve Number (CN) vary from 75 to 90
- Rainfall intensity based on Halifax International Airport IDF curves derived from Environment Canada Data – Short Duration Rainfall Intensity – Duration – Frequency Data (2019/02/27)
- Net-zero run off

Halifax International Airport IDF Curves



Hydrograph by Return Period

Project Name:

Hydrology Studio v 3.0.0.11

08-07-2019

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	NRCS Runoff	Pre A1		3.531		9.641	20.18			37.47
2	NRCS Runoff	Pre A2		3.075		8.397	17.58			32.64
3	NRCS Runoff	Post B1		5.232		12.16	23.12			42.02
4	NRCS Runoff	Post B2		20.16		30.53	39.76			65.41

Runoff Curve Numbers

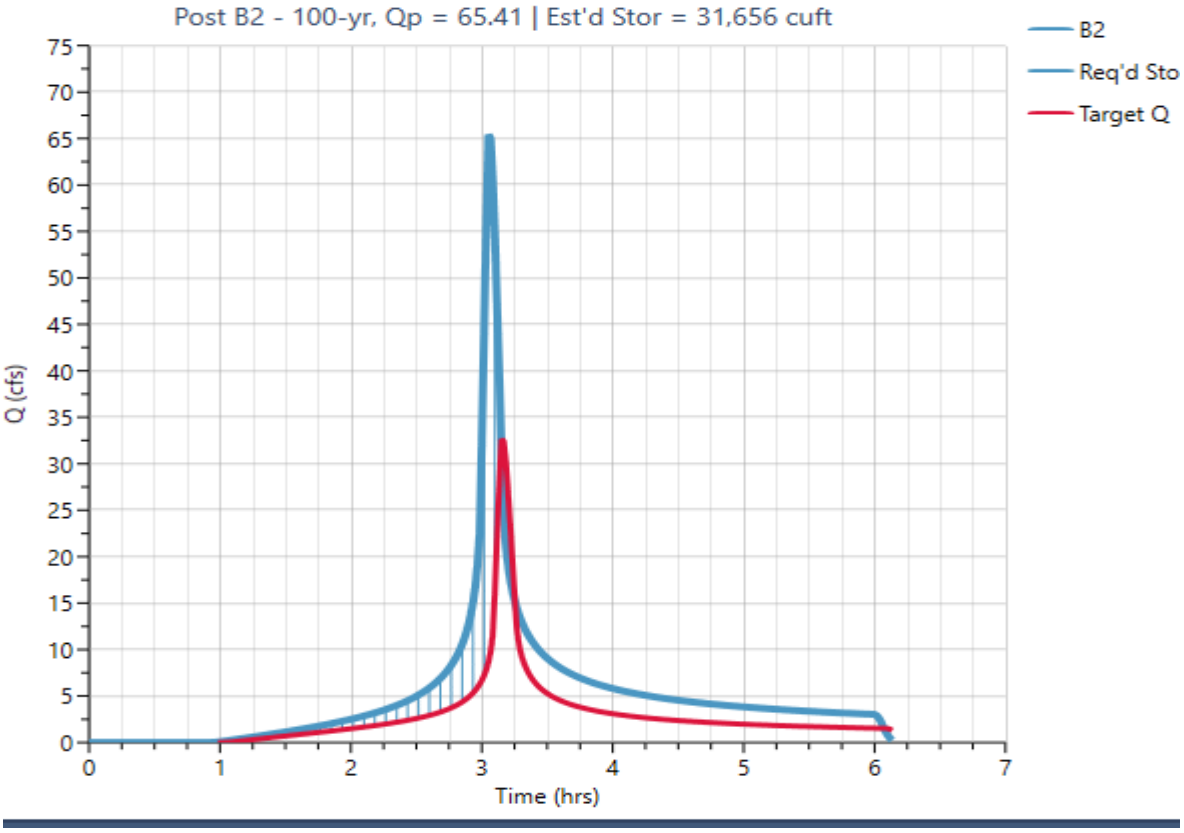
	Area (ac)	C value	Comments
Pre A1	15.5	75	Unimproved, treed
Pre A2	13.5	75	medium slope, treed
Post B1	15.5	77	weighted residential
Post B2	13.5	90	weighted residential

Peak Flow Summary

Since the 100-year storm is the most significant, we have used this storm data to determine the difference between pre and post development storm water runoff. The post development peak flow is 65.41 cfs, whereas the pre development peak flow is 42.02 cfs, a difference of only 23.39 cfs. This difference would necessitate the construction of a detention storage for this project. However, we feel the detention could be constructed in phases as the project progresses.

Stormwater Storage Estimate

The diagram below is used to determine the size of storage that could needed to provide a truly “net zero” effect. The estimated storage required is 31,656 cubic feet.



5.0 MITIGATION MEASURES

Given the large volume of residual rainfall, the very short time of concentration and the non-linear relationship of rainfall intensity to time, regulating agencies have dictated a "net zero" mitigation response. "Net zero" means the post-development rainfall runoff cannot exceed the pre-development rainfall runoff.

5.1 EROSION AND SEDIMENTATION CONTROLS

Although we feel the proposed development will cause an increase in drainage flows, concentration, erosion, and sedimentation this impact can be eradicated by proper mitigation techniques; therefore, we are recommending the following course of action be taken:

1) Ensure that all construction is in accordance with the terms and procedures in the NSDOE Erosion and Sedimentation Control Handbook. All silt and sedimentation must be contained on-site during development and construction.
2) Any open ditches or channels shall be rock lined, complete with the appropriate number of ditch plugs (control dams).
3) Siltation fencing shall be placed at the disturbed area boundaries of the property, checked regularly; the silt removed and disposed of off-site.
4) During construction, all storm sewer grates on the site shall have filter fabric placed between the frame and grate to stop all siltation from entering the any watercourse.
5) All slopes steeper than 2:1 from the construction shall be stabilized with 6 inch minus rock.
6) The increased runoff concentration from the proposed development should be collected in a new stormwater collection system, and connected detention storage facility, which will then exit the property.
7) Inform the HRM and NSDOE immediately whenever any siltation flows from the project to unnamed watercourse.
8) ***All the above measure shall be in place BEFORE construction starts.***

6.0 CONCLUSION

Due to topographical changes on the final development, there will be an increase in the total storm runoff discharge. All storm water that is collected from the development will be routed to the detention storage areas and the exit the property.

Given the existing pipe layout, the increase in stormwater runoff, and the estimated storage volume a detention structure is necessary for this project. However, we feel the detention storage could be partially constructed as the progress of the development continues. The increase in runoff could be mitigated with the use of ditch plugs in the armoured ditch.

Both erosion and sedimentation control measures have been accounted for in the management plan to minimize the impact of this development on the existing and future environmental features, on or near the property.

7.0 RECOMMENDATIONS

Although the overall storm flows will increase with development, this impact can be eradicated by proper mitigation and storage techniques. It is our recommendation the following action is taken:

1. The Developer shall ensure that all construction is in accordance with the terms and procedures in the NSDOE Erosion and Sedimentation Control Handbook. Efforts to contain silt and sedimentation onsite during development and construction shall be undertaken.

2. Any open ditches or channels shall be rock lined, complete with the appropriate number of ditch plugs (control dams). Detailed construction plans will identify the location and quantity of the ditch plugs.

3. A detention pond need not be constructed during the early stages of construction; but could be partially constructed and expanded as the subdivision develops. However, we will restrict the flow to pre-development levels by installing ditch plugs in any armoured ditches.

Appendix "A"

Basin Model

Hydrograph Summary

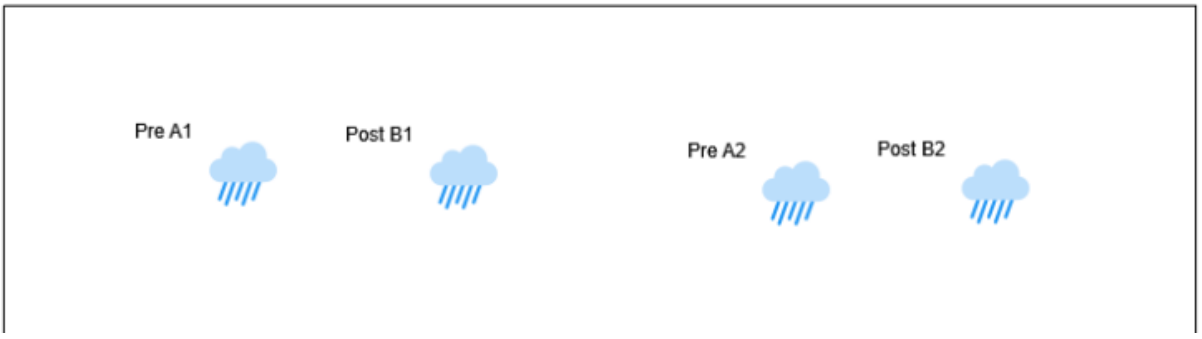
Environment Canada Rainfall Data

Basin Model

Project Name:

Hydrology Studio v 3.0.0.11

08-08-2019



Hydrograph 2-yr Summary

Project Name:

Hydrology Studio v 3.0.0.11

08-08-2019

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre A1	3.531	3.12	11,747	----		
2	NRCS Runoff	Pre A2	3.075	3.12	10,231	----		
3	NRCS Runoff	Post B1	5.232	3.10	14,506	----		
4	NRCS Runoff	Post B2	20.16	3.07	38,365	----		

Hydrograph 5-yr Summary

Project Name:

Hydrology Studio v 3.0.0.11

08-08-2019

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre A1	9.641	3.08	22,983	----		
2	NRCS Runoff	Pre A2	8.397	3.08	20,017	----		
3	NRCS Runoff	Post B1	12.16	3.08	26,967	----		
4	NRCS Runoff	Post B2	30.53	3.07	56,613	----		

Hydrograph 10-yr Summary

Project Name:

Hydrology Studio v 3.0.0.11

08-08-2019

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre A1	20.18	3.07	52,809	----		
2	NRCS Runoff	Pre A2	17.58	3.07	45,995	----		
3	NRCS Runoff	Post B1	23.12	3.07	59,028	----		
4	NRCS Runoff	Post B2	39.76	3.05	96,655	----		

Hydrograph 100-yr Summary

Project Name:

Hydrology Studio v 3.0.0.11

08-08-2019

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre A1	37.47	3.07	69,153	----		
2	NRCS Runoff	Pre A2	32.64	3.07	60,230	----		
3	NRCS Runoff	Post B1	42.02	3.07	76,296	----		
4	NRCS Runoff	Post B2	65.41	3.05	116,300	----		

Appendix B

Plan #Y2019 059-02
Drainage Plan - Pre - Development

Plan #Y2019-059-03
Drainage Plan - Post - Development

N

60m
55m
50m
45m
40m
35m
40m
35m
40m
45m
40m
35m
35m

AREA A1
15.5 Ac.

AREA A2
13.5 Ac.

0 200' 400'
SCALE

PERRY LAKE DEVELOPMENTS
FALL RIVER SOUTH
PRE-DEVELOPMENT STORM
Y2019-059-02

AUG 08, 2019

ABLE
Engineering & Land Surveying Services

N

P.I.D. 40844383

HALIFAX REGIONAL MUNICIPALITY PARKLAND

Ex WETLAND / SWAMP AREA

LOT 303
P.I.D.
40844383

P.I.D.s
40844375
40551277
00472910

AREA B1
15.5 Ac.

AREA B2
13.5 Ac.

TOWNHOUSES

40 UNIT

40 UNIT

40 UNIT

STORMWATER MANAGEMENT AREA

THIS AREA LEFT NATURAL

EXISTING TRAIL

Ex TRAIL

SF

WINLEY DRIVE

INGRAM DRIVE

BOLTON DRIVE

CANADIAN NATIONAL RAIL

COBEQUID ROAD

HIGHWAY 102

TRURO

HALIFAX

THREE MILE LAKE

60m

55m

50m

45m

40m

35m

0 200' 400'

SCALE

PERRY LAKE DEVELOPMENTS
FALL RIVER SOUTH
POST-DEVELOPMENT STORM
Y2019-059-03

AUG 08, 2019

ABLE
Engineering & Land Surveying Services